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Final Report

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Efficacy Test on Blackfly Larvicide (BTH) A New Application Method for Problem Areas of The Saskatchewan River

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Efficacy tests on blackfly larvicide (BTH) : a new application method for problem areas of the Saskatchewan River

an Agriculture Development Fund Research Project

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Abstract:

A new method of BTH application provided 95-100% elimination of blackfly larvae in areas where traditional methods failed to give control. The old method relied on water current to carry a single point application of pesticide through the length of the treatment zone; the new method used the same quantity of pesticide but involved moving a boat and sprayer through the treatment zone.

Project Objecive:

To find a solution to the severe blackfly outbreaks which occur frequently in late summer along the South Saskatchewan River, from St Louis to the river forks.

Key Words

BLACKFLIES, LARVAE, LARVICIDE, TREATMENT FAILURES, SOUTH SASKATCHEWAN RIVER, BTH, LIVESTOCK PROTECTION, BOAT MOUNTED SPRAYER

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Summary

Efficacy tests on blackfly laricide (BTH): a new application method for problem areas of the Saskatchewan River. D M Lehmkuhl

Blackfly outbreaks occurred almost every year in the South Saskatchewan River between St. Louis and the river forks because river conditions (weed growth, low water) caused traditional treatment methods to become ineffective. A new method of BTH application provided 95-100% elimination of blackfly larvae. The new method used the same quantity of pesticide but invdved moving a boat and sprayer through the treatment zone, in contrast to the old method which relied on point injections. Zones of 40-50 km in length could be easily treated without undue labour or inconvenience.

Acknowledgements

This project was funded by the Saskatchewan Agriculture Development Fund. I thank Roger Fry for technical discussions in the developmental stages, and for being available to answer administrative questions as the project was under way.

Scott Lipsit, Bob Rudachyk, and Rob Marcela are sincerely thanked for their willing and able help and assistance in the field and in the laboratory. I emphasize again the contributions of co-investigator Lloyd Saul to the project.

Introduction and brief description of the project

In the 60 km of South Saskatchewan River between St. Louis and the river forks, major blackfly outbreaks are a frequent occurence in late summer. River treatment methods against blackfly larvae which have been used in the past failed to give satisfactorally results in mid- and late summer, water levels were often low and there was heavy weed growth. Slow current and weed growth probably filtered and settled out the BTH larvicide, and large numbers of blackfly larvae escaped the effects of treatment, resulting in outbreaks of adult flies.

Discussions lead to the idea of a boat operated sprayer which would provide maneuverability and precision of application in weed beds, rapids, and pools which characterize the river. A test project was designed and an application to the Agriculture Development Fund resulted in a research grant for evaluating the new method.

Detailed Background Information

In the "blackfly zone" of Saskatchewan, roughly from Prince Albert and east to Choiceland, Gronlid, and Nipawin, it has been estimated that blood-feeding adult female blackflies , through biting and harassment, can cause losses of two or three million dollars per year of unrealized calving and weight gain in cattle (Fredeen, F. J. H. 1985. Some economic effects of outbreaks of Blackflies in Saskatchewan, Quest. Ent. 21:175).

Since the late 1940's, attempts have been made to control blackflies, especialy by targeting the breeding habitat and larvae which live in flowing water (Fredeen 1985, above).

In the last 10 years, using the groundwork that had been laid in the previous decades, control has been achieved over severe outbreaks and economic losses have bee held to a minimum (see minutes of recent annual meetings on blackflies, Sask. Ag.). Abatement has been possible because new products have become available that are not ecologically noxious (BTH), monitoring methods of measuring larval populations have been improved, timing and spacing of larviciding treatments have beeen refined, and new breeding habitats, especially the Torch River and tributaries have been identified, and treatment has been extended into these areas (see Biosystems-Lehmkuhl, numerous research and treatment reports, 1981-1988, on file with Saskatchewan Agriculture).

However, obstacles remain for delivering a completely satisfactory treatment program, and one of the most pressing is the treatment of the South Saskatchewan River between St. Louis and the forks of the river (personal communication-Roger Fry; also minutes of the Blackfly Advisory Committee). Residents of this area often register major complaints.

The explanation is probably that in late summer in the South Saskatchewan River, water levels drop, water is warm and clear, and well fertilized from Saskatoon sewage. Extensive beds of weeds become established. The growing tips of plants provide an excellent habitat for the development of millions of larvae. In addition , plant mats and plant beds function as filters and screens which remove larvicides from the flowing water. When this happens, larvae are not eliminated by treatment, adults emerge, and producers in the area experience severe problems. Livestock suffers, and Agriculture offices in Regina and elsewhere recieve complaints from residents.

Methods

Basic equipment and research methods have been tried and tested by us in past years in the Saskatchewan blackfly program. In this project they were applied in new combinations.

Sprayers

Standard backpack sprayers that had previously been used for point treatments were operated from a boat.

Boats

A 20 ft. flat-bottomed river boat with motor provided a reliable work platform. The boat was used to travel the lenght of the test area and apply the BTH treatment with sprayers. In some cases, a small, 2-man flat bottom boat was substituted.

Samplers

Tape samplers of the type that have been used for monitoring and research for many years in the control program were used in this project. Sample substrates (tape samplers) were attached to floating bouys a few days before treatment; larvae colonized the sampler substrates; a set of three samples was collected before treatment and a matching set of three samples was collected 48 hours after treatment. Before-after comparisons were made and effectiveness was determined.

Sample Stations

A number of sample stations were established in the problem area (St. Louis bridge, 2 km downstream from St. Louis (Horse Ranch), Sugar Island, Brewster's Farm, Fenton Railroad Bridge, Fenton Ferry, Birch Hills Ferry , "Junkyard" site, Ruszkowski's farm, Weldon Ferry, Weldon Ferry Rapids (Nude Beach) , the river forks at McDonald's Farm, and the true river forks).

Dosage

This was according to manufacturers recommendations, and calculations indicated a rate of 20 l of BTH per 5 km of river.

Sample dates

Field experiments were conducted 8-10 August in the St. Louis to Fenton Ferry section of river. From Birch Hills ferry site to the river forks, tests were carried out from 9-11 August. Tests were made from Birch Hills Ferry to Weldon ferry August 15-17. A test was also conducted 5-9 Sept. in the Birch Hills to Weldon Ferry area.

Samplers were set 3-4 days before treatment, pre samples were picked up just hours prior to treatment, and post samples were picked up approximately 48 hours after treatment.

Laboratory Analysis

In each sample, all specimens were identified to species and the instar was determined.

Field procedure for the new method

This section discusses the acutal procedure, combining the above methods with other preparations and techniques.

First, it was necessary to have intimate knowledge of the 60 km of river involved. Familiarity gained in past years was supplemented by observations made by road or boat travel. Notes were made on maps regarding major rapids, sand bars, islands, or other features.

In particular, it was necessary during actual treatment for the project leader to recognize landmarks so that exact location could be determined at all times for the proper application of the pesticide dosage. It was specially important to recognize the 5 km end points. The 20 l of BTH was sprayed slowly into the water as the boat traveled from Km 0 to km 5. Then a new allotment of 20 l was begun when the 5 km point was passed.

The old method would have been to pour the 20 l of BTH into the river at km 0 and let it be carried, hopefully, by current, to Km 5.

In the new method, during the trip from Km 0 to km 5, the project leader communicated to the boat and sprayer operators, calling for pauses in spraying in the large, still-water pools that are common in some areas, calling for extra spray at the heads of rapids, and guiding the boat operator. When current and river conditions allowed, figure-8 paths of spraying were often made above areas of rapids. Often, both sides of large islands were treated

The above sounds quite straightforward as described, but of course it involved dealing with the irregularities of the river. Frequently, the river spread into a wide, shallow area of cobble and stones, and it was necessary for the crew to physically drag a heavily loaded boat through such areas. Often the river was too shallow and rocky to use a propeller driven boat, and paddling by the crew was necessary. Many times there were violent encounters between the boat and hidden, submerged rocks. It can be dangerous to unexpectedly come upon major rapids in fast current. However, an experienced and knowledgeable crew, properly fitted with life jackets, etc., are in no danger, and can cope with this as well as the proper application of pesticide.

Results

Results are summarized in Table 1. At 14 sample stations, only two stations showed control under 90 %, that is, 86 and 88 % reduction at Brewster's Farm and Sugar Island respectively on our first attempt.

At 11 of 14 sample stations, reduction was 97-100 %.

Details for the sample stations are given in figures 1-11. Samples 1, 2 and 3 are tape samples, and sample 4 is a vegetation sample. On some occasions, the pre-sample had 0 or very few larvae. This was because the samplers were fouled by floating weeds. However, it is obvious from Figures 1-11 that large populations established themselves on the pre samplers, while very few larvae remained after treatment. In Figures 2 and 3, a few larvae remained on the post- samplers. We judge that this was because of the inexperience of our first attempt, and that the samplers were in an "island shadow", thus not exposed to pesticide. We feel that our experience will now eliminate such escape areas. We now maneuver the boat and spraying procedure so that even these larvae will be eliminated.

Table 2 gives examples of the instar and species structure of the populations in the river. All instars and species were elimniated equally by the new application technique. In Table 2, Example 1 is dominated by S. vittatum, while in Examle 2 S. luggeri is the dominant species. All instars are represented, especially instars 4 and 7. All were eliminated by 98% or more.

Table 1. Summary of results. Numbers shown for experiments 1, 2 and 3 are sums for pre and post, from Figures 1-11. Numbers in Experiment 4 are total larvae on a single tape.

Experiment 1, St. Louis to Fenton Ferry; 8-11 August 1989; total larvae, 4 samples combined.

site	pre	post	% reduction (rounded)
Horse Ranch	278	8	97%
Sugar Island	312	37	88%
Brewster's	675	97	86%
Rail Bridge	681	0	100%
Fenton Ferry	154	2	99%

Experiment 2, Weldon Ferry to Confluence, 9-12 August 1989, total larvae, 4 samples combined.

site	pre	post	% reduction (rounded)
Nude Beach	182	1	99+%
McLeods	392	11	97%
McDonald's	4066	15	99+%
Confluence	1501	87	94%

Experiment 3, Ruszkowski's to Weldon Ferry, 15-17 August, 1989, total larvae, 4 samples combined.

site	pre	post	% reduction (rounded)
CO-Op Farm	132	0	100%
Weldon Ferry	322	1	99+%

Experiment 4. Burn's to Weldon Ferry, 5-9 September 1989, total larvae on single tape samples.

site	pre	post	% reduction (rounded)
Birch Hills	839	0	100 %
Ruszkowski's	36	0	100 %
Weldon Ferry	414	4	99%

Table 2. Examples of species and instar structure of blackfly populations in the test area. All species and instars were eliminated.

Example 1. Horse Ranch , pre- sample #1 (vegetation), 8 August 1989. Compare with Figure 1. Total larvae pre- 221; total larvae post on vegetation- 5, i.e., approx 98% reduction.

species	instar 1	2	3	4	5	6	7
S. luggeri	0	0	0	0	1	6	2
S. vittatum	0	2	4	9	24	71	199
S. sp ?	0	0	0	0	0	1	2

Example 2. McDonald's Confluence, pre sample tape #2; 9 August 1989. Compare with Figure 8. Total larvae on pre tape #2-1130; 99% reduction at this site (Table 1).

species	instar 1	2	3	4	5	6	7
S. luggeri	40	50	260	450	30	10	30
S. vittatum	0	0	0	60	40	60	40
S. sp ?	0	0	20	30	0	0	10

Discussion and conclusions.

A major feature of the distribution of BTH using the new method should be pointed out. In the old method, km 0-1 received the full impact of 20 l of pesticide, and it can be assumed that concentration then became reduced with distance as particles settled out (#2, Appendix 1). In the new method, the areas near km 0 and 1 received very little BTH - only 3 or 4 l were applied to this entire distance. The total 20 l was spread over 5 km (#4, Appendix 1). Yet, control at km 1 was complete even though the concentration of BTH would logically seem to be low (Horse Ranch, Nude Beach, Figs 1 and 6 in this study)

The new application method was 97-100% effective in nearly all cases. The logistic and practical problems of the method are not greater than was the case in the old method, where it was necceary to cope with muddy roads and lack of boat launching sites.

The new method has exceded the highest expectations of the investigators regarding the control of larvae in the South Saskatchewan River.

Recommendations

The program for control of blackfly larve in the South Saskatchewan River should move quickly and completely toward the the new method of BTH application, as described on pp. 3-4 of this report. A method now exists, which, during tests, completely eliminated (97-100%) blackfly larvae in the South Saskatchewan river.

Appendix 1

Project overview in diagrams

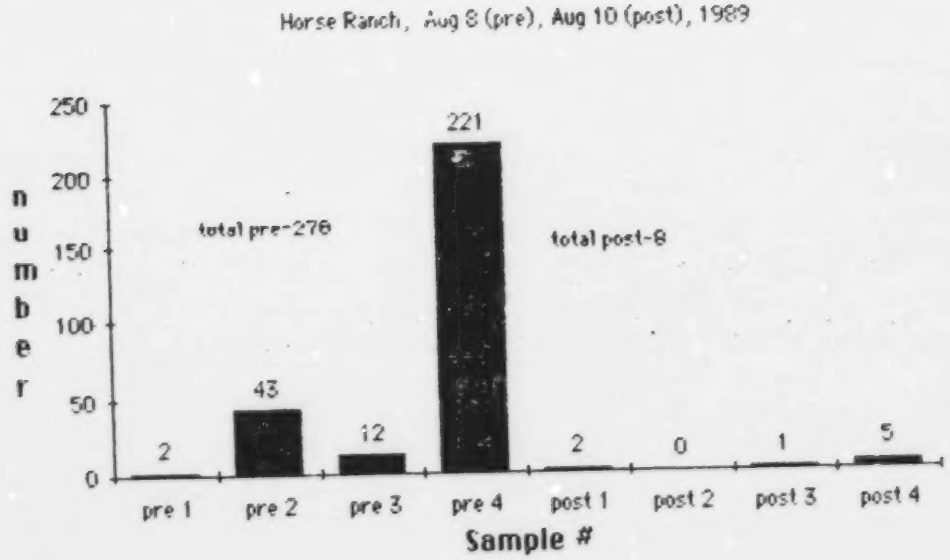
Figure 1 (points 1-4) reviews the problem and summarizes the procedure.

- #1 and #2, diagram- current procedures and theory.
- #3-reasons for failure using current methods
- #4- proposed procedure to be tested.

Appendix 2

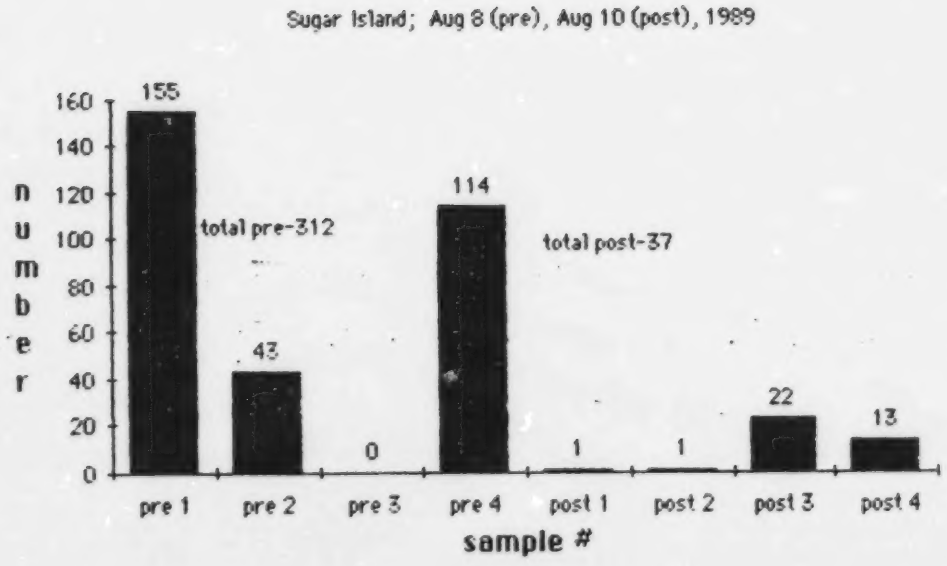
Map of the study area

Fig. 1



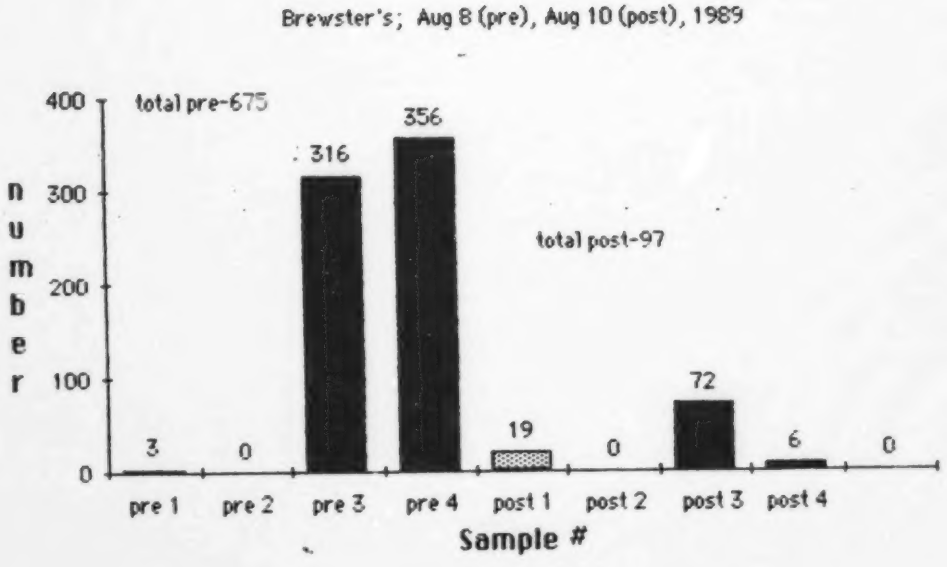
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 2



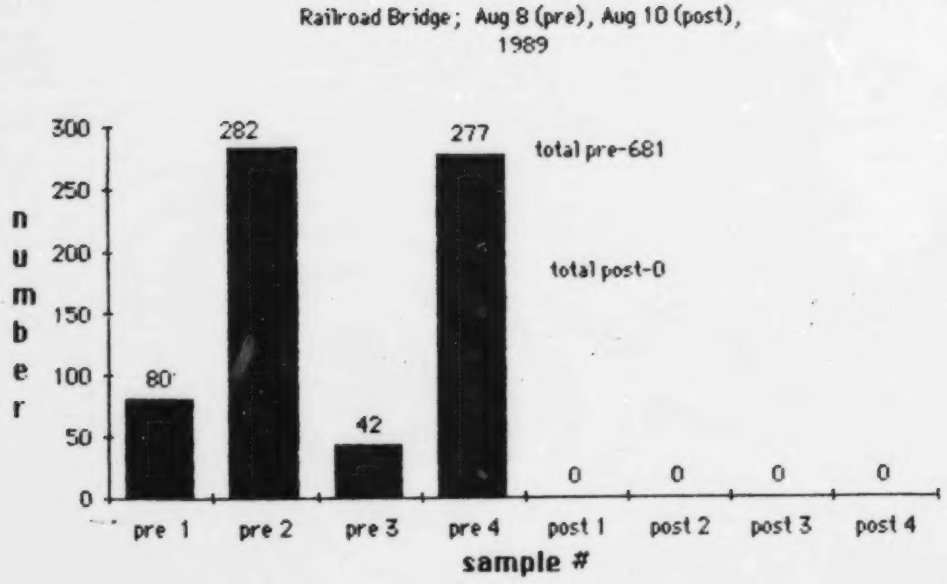
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 3



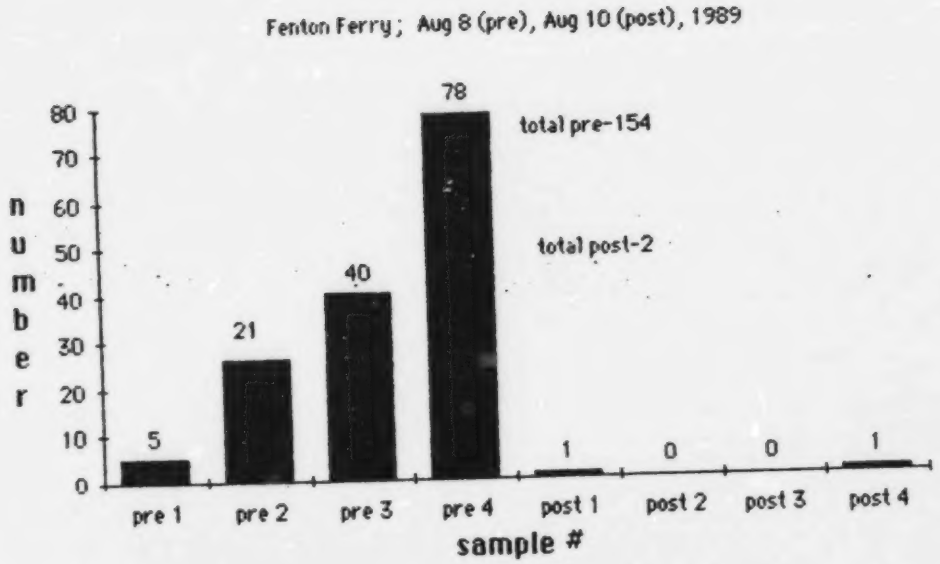
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 4



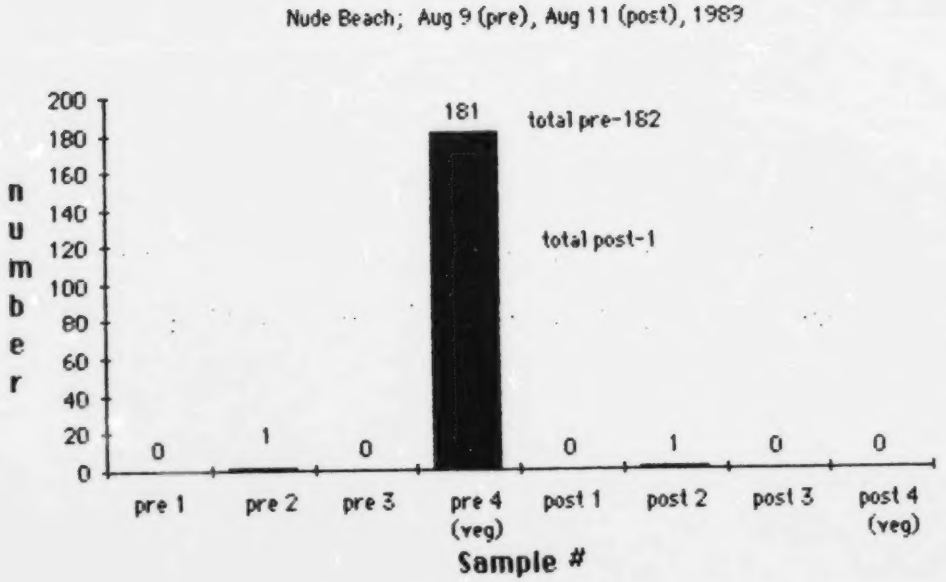
Number of larvae pre and post treatment: 4

Fig. 5



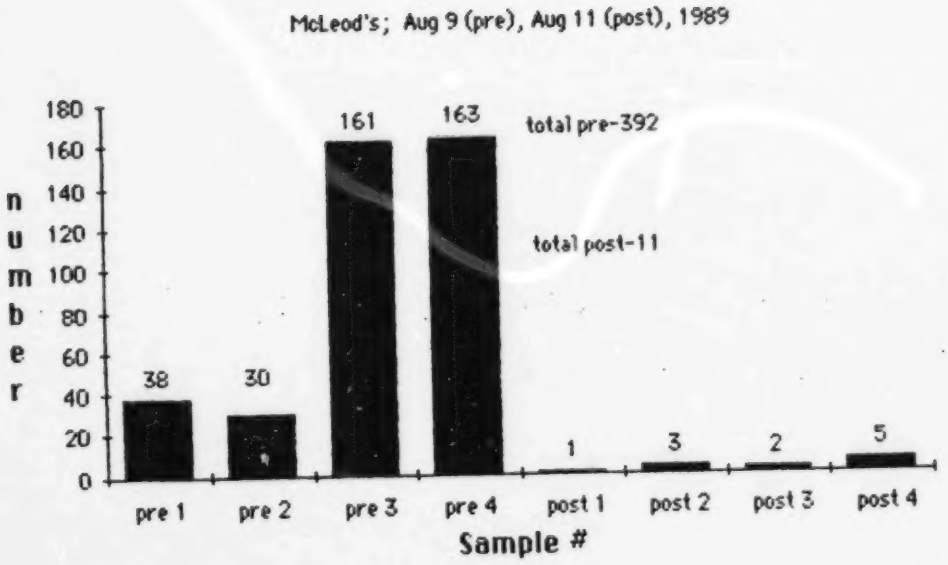
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 6



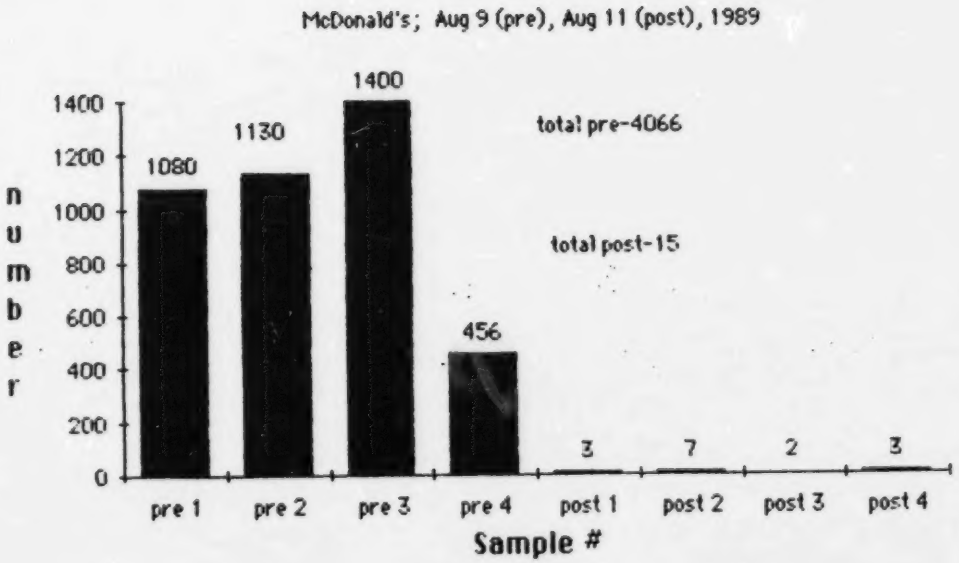
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 7



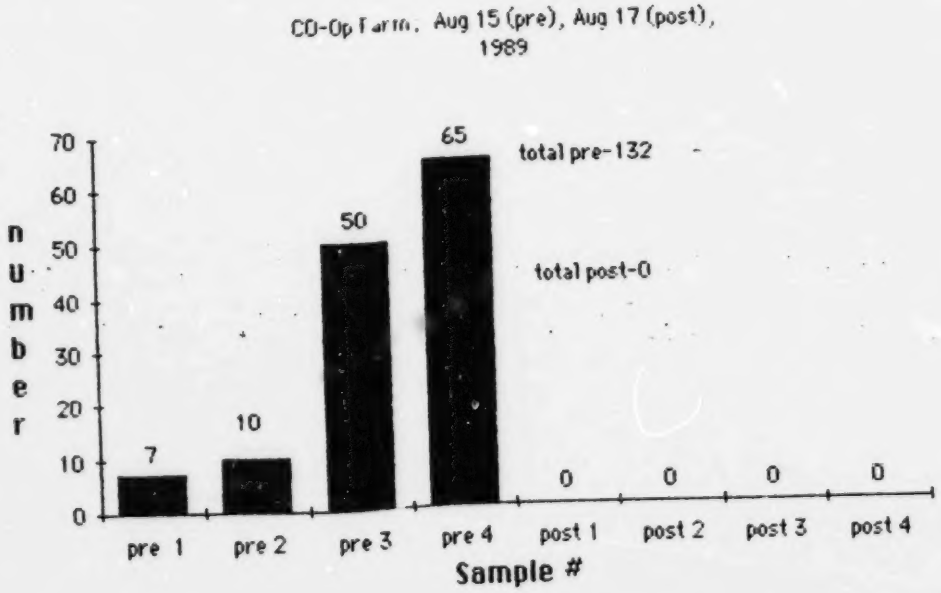
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 8



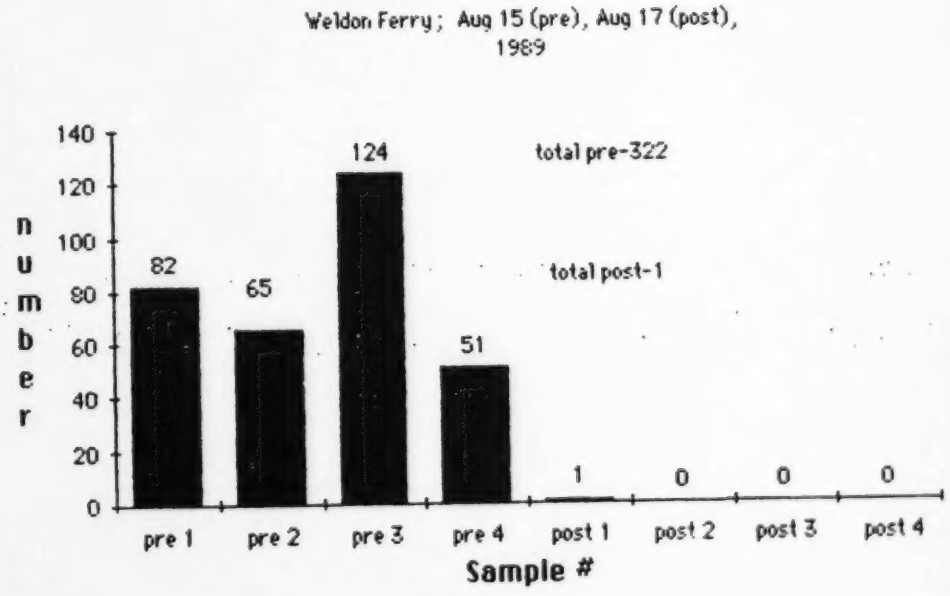
Number of larvae, pre and post treatment, 4 replicate samples.

Fig. 10



Number of larvae, pre and post treatment, 4 replicate samples.

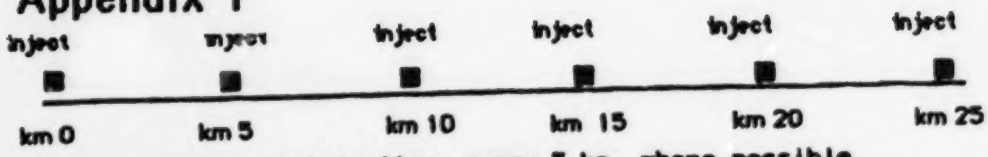
Fig. 11



Number of larvae, pre and post treatment, 4 replicate samples.

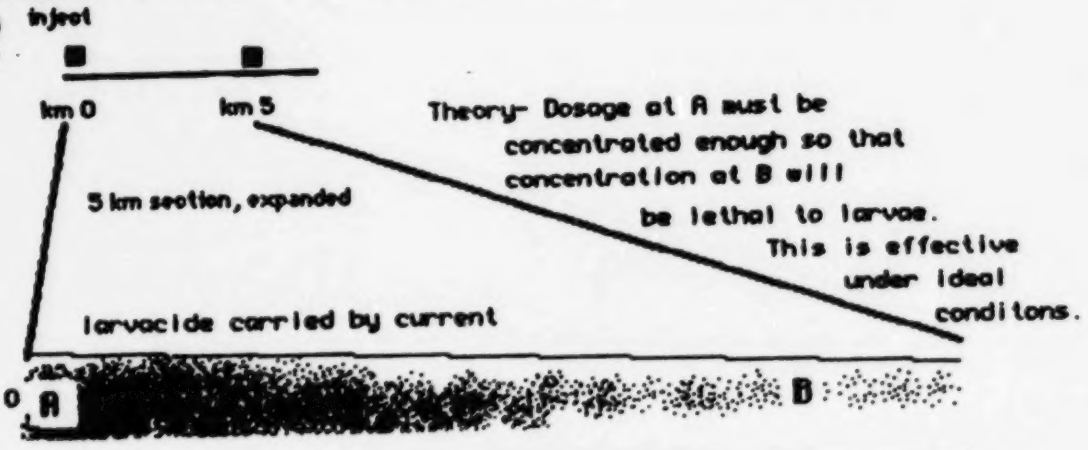
Appendix 1

1

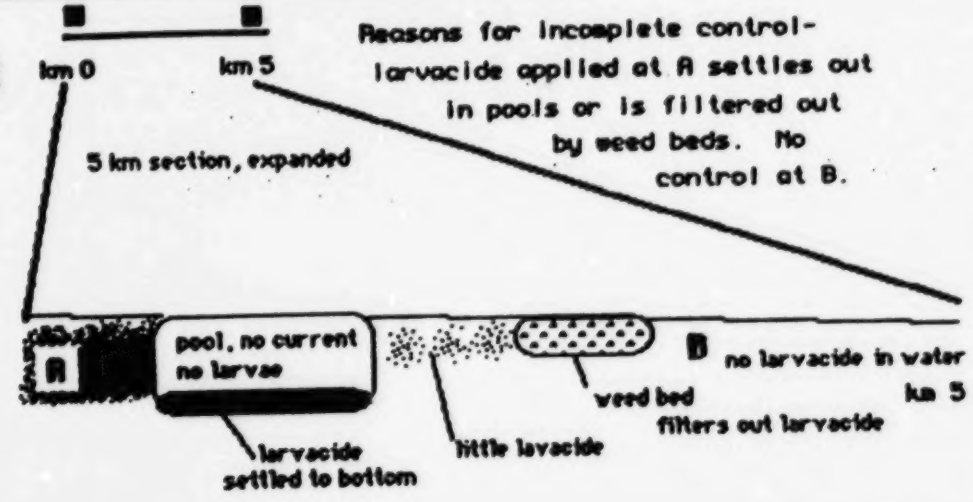


Current pattern of injection, every 5 km, where possible.
Larvacide is injected at a point, carried by current to next site.

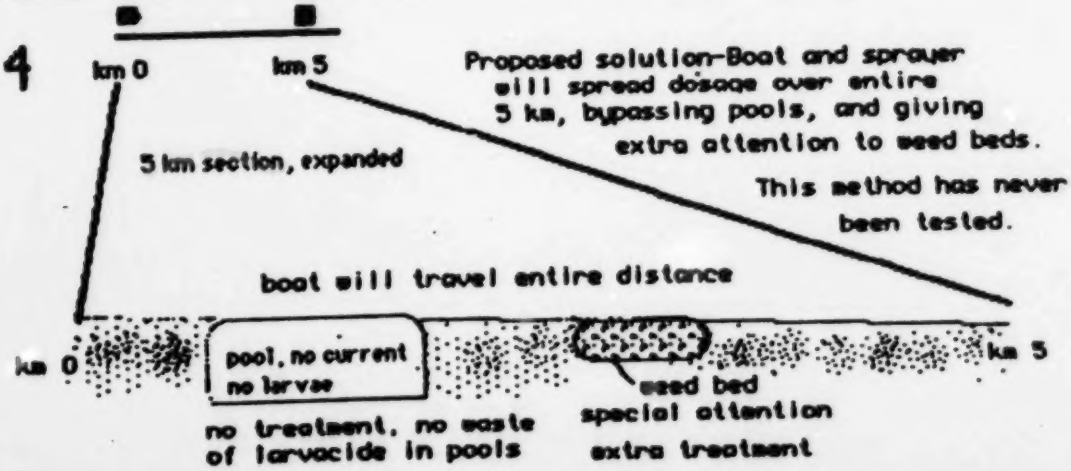
2


inject
km 0
km 5
5 km section, expanded
Theory- Dosage at A must be concentrated enough so that concentration at B will be lethal to larvae. This is effective under ideal conditions.
larvacide carried by current
km 0
A
B

3



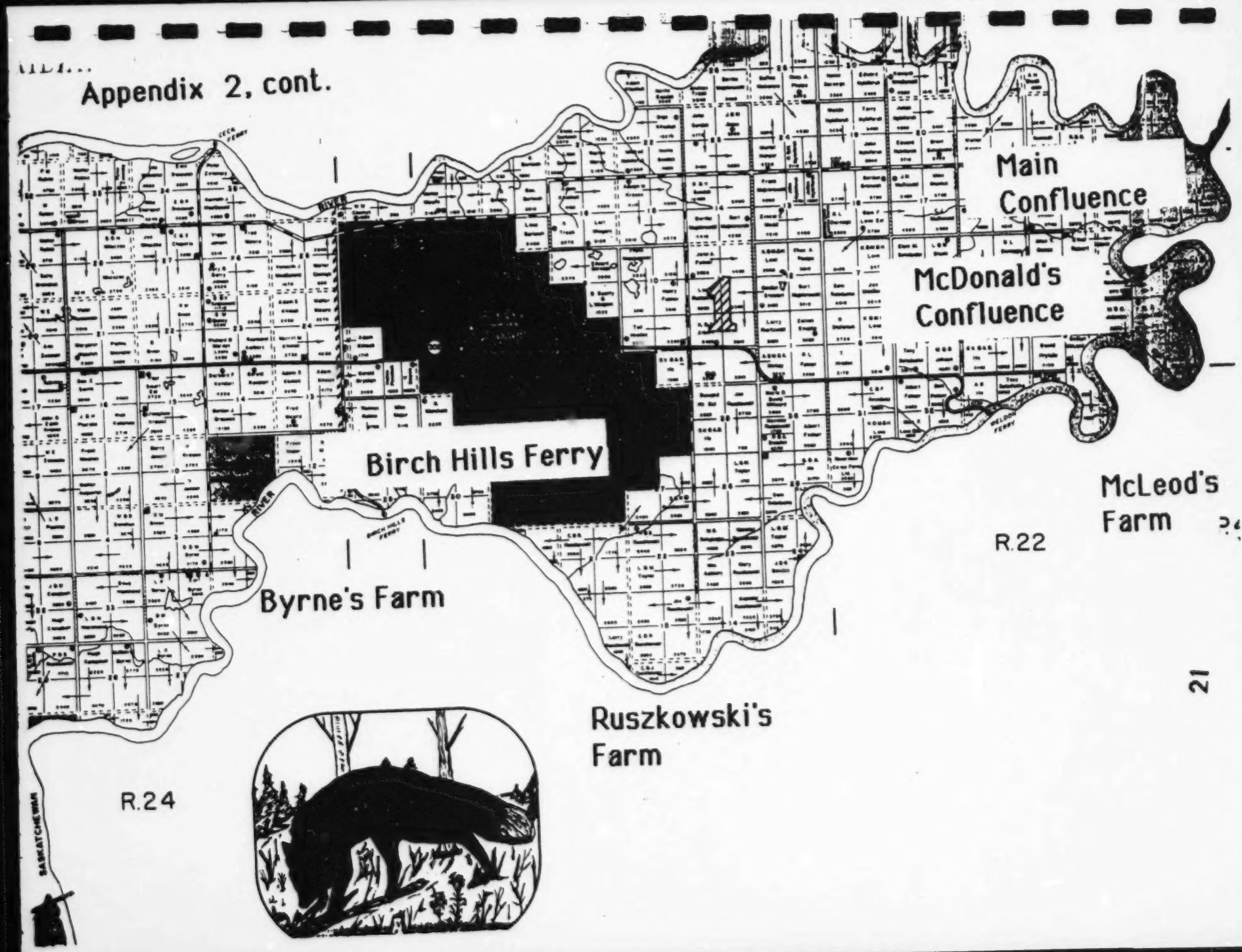
4


km 0
km 5
5 km section, expanded
Proposed solution-Boat and sprayer will spread dosage over entire 5 km, bypassing pools, and giving extra attention to weed beds. This method has never been tested.
boat will travel entire distance
km 0
pool, no current
no larvae
no treatment, no waste
of larvacide in pools
weed bed
special attention
extra treatment
km 5

Appendix 2

Fenton Ferry
Brewster's
Fenton Ferry
Railroad Bridge
...25
20
Sugar Island
R.26
SUBDIVISION "A"
"Horse Ranch"
St. Louis

Appendix 2, cont.



FINAL REPORT SUPPLEMENT, for BTH, A NEW APPLICATION METHOD

ADF Project V-89-01-0242, Saskatchewan Agriculture, 1989

Further information and responses, as requested by Calvin Mulligan; prepared by D. M. Lehmkuhl, March-May, 1990.

(References to numbered paragraphs relate to the attached memo from Calvin Mulligan, 26 Jan. 1990).

1. (Paragraphs 2 and 3)
Pros and cons of implementation of the new method-a comparison of costs and hazards in relation to efficacy.

Efficacy

I have recommended that the Blackfly Control program switch completely and immediately to the new method in the South Saskatchewan River. In terms of efficacy, the elimination of all instars and species of blackflies was near 100 % in our experiments. Thus, the method is successful from the point of view of control.

Possible Objections

Objections to the new method might include such factors as costs, safety, or inconvenience.

To compare the two methods, the old method required, on average, twenty liters of pesticide per 5 km of river, a crew of 3 or 4 trained persons, a boat, vehice(s) for road transportation of crew and equipment, and about two days total time to cover all sections of the river from St. Louis to the River forks.

The old method required driving from one 5 km site to the next, and using a boat launch or walk-in method to treat each site. This involved manual labour of carrying pails and equipment, and could be very tedious if road accesses to the 5 km. sites are made impassable by rain and long walks and heavy loads are sometimes involved. Conditions were unpredictable (depending on rain and weather), and using the old method the work could be labour intensive and even dangerous.

The new method used the identical amount of pesticide and could be done with an identical crew and equipment. While in the new method the

crew might have to drag a heavy boat through shallow rapids, in the old method they were equally likely to have to drag heavy equipment through a muddy field, from the truck to the river. Regarding danger while in the boat, the new method involves more time on the water, but the old method also involved working from a boat under equally critical and exacting conditions.

Conclusion regarding implementation

There is no qualitative increase in the hazardous or dangerous aspects of the work, nor in the heaviness of the labour between the two methods. The new method allows more control over unpredictable conditions, since the boat can be launched at a convenient rather than a difficult site, and it can be loaded with the supplies needed to cover several 5 km. sections if conditions at intermediate sites are impassable by road.

The judgement and decisions are similar in both methods. It should be emphasized that in both cases, experienced persons must be in charge and competent and experienced crews are essential.

2. (paragraph 3)

New and Alternative Efficiencies.

Queried in Calvin Mulligan's memo are new technologies, such as boom sprayers and hovercraft. While there is nothing to prevent the development and testing of alternative technologies (the memo mentions finger-tip boom-sprayers), I feel that these ideas have already been considered and rejected, based on expense, break-down potential, and inflexibility. Both the old and new methods rely on standard backpack sprayers and flat-bottomed power boats for actual application of BT. There are no problems with existing techniques in these areas, so I do not recommend a major effort in looking for alternatives.

3. (paragrpah 4).

Operator Knowledge.

While the memo questions whether the effectiveness of the new method depends on operator knowledge of the river system, this is equally true of the old method. Nothing needs to be added to this report that is peculiar to the new method. Both the old and new methods require a great degree of knowledge of river topography, access roads, monitor methods, blackfly identification and seasonal changes in the system. Regardless of what method is used, a period of training and apprenticeship is necessary.

Updating Operator Knowledge of the System

At the time of this writing (May 1990), water flow in the South

Saskatchewan River river is about 3 times greater than it was a year ago; thus, former access sites are now flooded, islands have become submerged, former rapids are under deep water, and rocks formerly on the shoreline are now navigation hazzards. It is clear that knowledge of topography and current conditions must be reviewed and updated by maps and exploratory trips. Detailed municipality maps (see pp. 20 and 21 of this report) are available which show roads, buildings, and river islands.

The operator must make mental or written notes regarding landmarks, river islands, sand bars, rapids, etc. These change from year to year and through the season.

Flags on poles or vegetation, set prior to treatment, can be used to mark the 5 km segments if the operator is not confident of his knowledge of the area. The crew and boat operator can make practice runs to develop facility in detecting and dealing with rapids and avoiding rocks. There is no substitute for experience in lerning to deal with this.

4. (paragraph 6)

Monitoring

Calvins memo asks for comments on the monitoring system. The standard monitoring and treating method could be characterized as an attempt to detect "hot spots" through the use of a multitude of monitor stations, and then to use "crisis management" to suppress larval populations in the hot spots, while paying much less attention to the areas between the hot spots. On a treatment date, it has been the normal procedure to evaluate the monitor data and to select those sites that would be treated and to bypass the sites with low populations. This method was a procedure based on traditon that had built up over a decade or more, using not only BT but also Methoxychlor.

Based on 10 years of experience, I favor a new method of monitoring, which might be characterized as a holistic procedure. Monitoring should be an evaluation of the South Saskatchewan River **system**, not an evaluation of ten or more **individual sites**. The evlauation should be about the condition of the system, based on detailed information from specific sites.

Treatment, likewise, should be thought of as including the entire south river system. It should not be thought of as a case of selecting or rejecting treatment of a dozen individual sites.

In principle, I suggest that when **the river** merits treatment, **the river** should be treated throughout its length. The objective should be to stop thinking in terms or ten or a dozen monitor sites and the same number of treatment sites. This fragmented approach has proven to be inefficient and ineffective in the past.